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**BLENDS OF ESTERS WITH ISOMERIZED OLEFINS
AND OTHER HYDROCARBONS
AS BASE OILS FOR INVERT EMULSION OIL MUDS**

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BACKGROUND OF THE INVENTION**1. Field of the Invention**

The present invention relates to compositions and methods for drilling boreholes in subterranean formations, particularly hydrocarbon bearing formations. More particularly, the present invention relates to oil or synthetic based drilling fluids, fluids comprising invert emulsions, and more particularly to drilling fluids utilizing esters which combine high ecological compatibility with good stability and performance properties.

2. Description of Relevant Art

A drilling fluid or mud is a specially designed fluid that is circulated through a wellbore as the wellbore is being drilled to facilitate the drilling operation. The various functions of a drilling fluid include removing drill cuttings from the wellbore, cooling and lubricating the drill bit, aiding in support of the drill pipe and drill bit, and providing a hydrostatic head to maintain the integrity of the wellbore walls and prevent well blowouts. Specific drilling fluid systems are selected to optimize a drilling operation in accordance with the characteristics of a particular geological formation.

Oil or synthetic-based muds are normally used to drill swelling or sloughing shales, salt, gypsum, anhydrite or other evaporite formations, hydrogen sulfide-containing formations, and hot (greater than about 300 degrees Fahrenheit) holes, but may be used in other holes penetrating a subterranean formation as well. Unless indicated otherwise, the terms "oil mud" or "oil-based mud

or drilling fluid” shall be understood to include synthetic as well as natural or traditional oils, and such oils shall be understood to comprise invert emulsions.

Oil-based muds used in drilling typically comprise: a base oil (or synthetic) comprising the external phase of an invert emulsion; a saline, aqueous solution (typically a solution comprising about 30% calcium chloride and emulsifiers) comprising the internal phase of the invert emulsion; and other agents or additives for suspension, weight or density, oil-wetting, fluid loss or filtration control, and rheology control. An oil-based drilling fluid may commonly comprise between about 50:50 to about 95:5 by volume oil phase to water phase. An all oil mud simply comprises 100% oil by volume; that is, there is no aqueous internal phase.

Oil-based muds or drilling fluids comprise a key segment of the drilling fluids industry. However, increasingly oil-based drilling fluids have been subjected to greater environmental restrictions and performance and cost demands. There is consequently an increasing need and industry-wide interest in new low-cost drilling fluids that provide robust rheology at high and low temperatures simultaneously while still affording environmental acceptance.

SUMMARY OF THE INVENTION

A drilling fluid comprising an invert emulsion is provided in the present invention that provides significant benefits in terms of environmental acceptance or regulatory compliance without compromising or reducing oil mud rheology or overall oil mud performance significantly. The invert emulsion of the invention has a base, or continuous phase, comprising esters blended with isomerized, or internal, olefins and/or other hydrocarbons, such as paraffins, mineral oils, glyceride triesters, or combinations thereof (hereinafter “the ester blends”). Alternatively, the invert emulsion

has a base comprising isomerized olefins blended with other hydrocarbons such as linear alpha olefins, paraffins, or naphthenes, or combinations thereof (hereinafter "the hydrocarbon blends"). In still another embodiment, these two alternative base fluids may themselves be blended together to comprise the base of an invert emulsion.

5 In the ester blends, the ester may be any quantity, but preferably should comprise at least about 10 weight percent to about 99 weight percent of the blend and the olefins or other hydrocarbons should preferably comprise about 1 weight percent to about 99 weight percent of the blend. In the hydrocarbon blends, the isomerized olefins should preferably comprise about 1 weight percent to about 99 weight percent of the blend and the other hydrocarbons should preferably comprise about 1 weight percent to about 99 weight percent of the blend. In the alternative embodiment where the ester blends are blended further with the hydrocarbon blends, the esters may be any quantity, but preferably should comprise at least about 10 weight percent (and less than about 99 weight percent) of the final blend. The esters of the blends of the invention are preferably comprised of fatty acids and alcohols and most preferably about C₆ to about C₁₄ fatty acids and 2-ethyl hexanol. However, esters made other ways than with fatty acids and alcohols, such as for example, esters made from olefins combined with either fatty acids or alcohols, are also believed effective for use in the blends of the invention.

A method for preparing and using an environmentally acceptable drilling fluid is also provided by the invention. In the method, a drilling fluid is obtained or prepared comprising as its base or continuous phase the blends of the invention. The fluid is then used in drilling boreholes or wellbores in subterranean formations.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS.

The present invention provides blends that comprise the oil base or continuous phase of an invert emulsion for oil-based drilling fluids or muds that are environmentally acceptable and still effective as drilling fluids. The environmental acceptability or compatibility and retained effectiveness of the fluids for use as a drilling fluid are accomplished through the blending or mixing of the fluids.

In preparing the blends of the invention, preferably the blending or mixing is done, i.e., the blends are made, before the emulsion is formed or before other materials or compounds are added to the fluid.

The blends of the invention most preferably comprise esters, and also preferably comprise isomerized, or internal, olefins. However, blends of the invention may also or alternatively comprise esters with other hydrocarbons. Alternatively, blends of the invention may comprise isomerized olefins and other hydrocarbons.

In blends of the invention with esters, the esters may be used in any quantity. Preferably, however, the esters should comprise at least about 10 weight percent of the blend and may comprise up to about 99 weight percent of the blend. Preferred esters for blending are comprised of about C_6 to about C_{14} fatty acids and alcohols, and are particularly or more preferably disclosed in U.S. Patent No. Re. 36,066, reissued January 25, 1999 as a reissue of U.S. Patent No. 5,232,910, assigned to Henkel KGaA of Dusseldorf, Germany, and Baroid Limited of London, England, and in U.S. Patent No. 5,252,554, issued October 12, 1993, and assigned to Henkel Kommanditgesellschaft auf Aktien of Dusseldorf, Germany and Baroid Limited of Aberdeen, Scotland. Esters disclosed in U.S. Patent

No. 5,106,516, issued April 21, 1992, and U.S. Patent No. 5,318,954, issued June 7, 1984, both assigned to Henkel Kommanditgesellschaft auf Aktien, of Dusseldorf, Germany, may also preferably be used in the blends of the invention. The most preferred esters for use in the blends of the invention are comprised of about C₁₂ to about C₁₄ fatty acids and 2-ethyl hexanol or about C₈ fatty acids and 2-ethyl hexanol. These most preferred esters are available commercially as PETROFREE® and PETROFREE LV™, respectively, from Halliburton Energy Services, Inc. in Houston, Texas.

Isomerized, or internal, olefins for the blends of the invention may be any such olefins, straight chain, branched, or cyclic, preferably having about 10 to about 30 carbon atoms. Isomerized, or internal, olefins having about 40 to about 70 weight percent C₁₆ and about 20 to about 50 weight percent C₁₈ are especially preferred for blends of the invention. An example of an isomerized olefin for blends of the invention that is commercially available is SF™ Base, available from Halliburton Energy Services, Inc. in Houston, Texas.

As previously noted for the blends of the invention, esters may be blended with other hydrocarbons, in addition to or instead of with isomerized olefins. Particularly, for example, esters may be blended with paraffins, mineral oil hydrocarbons, and/or glyceride triesters, where such other hydrocarbons comprise from about 1 weight percent to about 99 weight percent of the blend.

Paraffins for the blends of the invention may be linear, branched, poly-branched, cyclic, or isoparaffins, preferably having about 10 to about 30 carbon atoms. When blended with esters of the invention, the paraffins should comprise at least about 1 weight percent to about 99 weight percent of the blend, but preferably less than about 50 weight percent. When blended with other hydrocarbons of the invention, particularly isomerized olefins, linear alpha olefins, or naphthenes

as will be discussed further below, the paraffins should comprise at least about 1 weight percent up to about 99 weight percent of the blend, but preferably less than about 50 weight percent of the blend. An example of a paraffin suited for blends of the invention that is commercially available is XP-07™, available from Halliburton Energy Services, Inc in Houston, Texas. XP-07™ is primarily
5 a C₁₂₋₁₆ linear paraffin.

Examples of glyceride triesters for the ester/hydrocarbon blends of the invention include without limitation materials such as rapeseed oil, olive oil, canola oil, castor oil, coconut oil, corn oil, cottonseed oil, lard oil, linseed oil, neatsfoot oil, palm oil, peanut oil, perilla oil, rice bran oil, safflower oil, sardine oil, sesame oil, soybean oil, and sunflower oil.

Further, the blends of the invention may be prepared from esters of the invention mixed with various combinations of the olefin hydrocarbons, paraffin hydrocarbons, mineral oil hydrocarbons and glyceride triesters, and even with the hydrocarbon blends of the invention (as the term “hydrocarbon blends” has previously been defined herein). In such combination blends, the olefin or other hydrocarbon combinations should preferably comprise about 1 to about 99 weight percent
15 of the blend and the esters of the invention should preferably comprise about 10 to about 99 weight percent of the blend, although any quantity of the esters may be used.

The hydrocarbon blends of the invention comprise isomerized olefins blended with other hydrocarbons such as paraffin hydrocarbons. That is, about 1 weight percent to about 99 weight percent isomerized olefins may be blended with about 1 weight percent to about 99 weight percent
20 linear alpha olefins, naphthenes, paraffins, or other similar hydrocarbons, or combinations thereof. The paraffin hydrocarbons may be linear, branched, poly-branched, cyclic, or isoparaffins preferably having about 10 to about 30 carbon atoms. The linear alpha olefins and the isomerized olefins

preferably have about 10 to about 30 carbon atoms. The isomerized olefins may be internal olefins (either straight chain or branched), cyclic olefins, or olefins with any other structure (preferably other than linear alpha). The naphthenes or naphthenic hydrocarbons may be any saturated, cycloparaffinic compound, composition or material with a chemical formula of C_nH_{2n} where n is a number about 5 to about 30.

These hydrocarbon blends may be further blended with the ester blends of the invention. In such blends, the esters may be any quantity but the esters preferably comprise at least about 10 weight percent and less than about 99 weight percent of the ultimate blend.

The exact proportions of the components comprising the blends of the invention will vary depending on drilling requirements (and characteristics needed for the blends to meet those requirements), supply and availability of the components, cost of the components, and characteristics of the blend necessary to meet environmental regulations or environmental acceptance. The manufacture of the various components of the blends of the invention will be understood by one skilled in the art.

According to the method of the invention, blends of the invention are obtained or prepared and used to comprise the oil (or synthetic) base of an invert emulsion or oil-based drilling fluid. The fluid is used for drilling a borehole or wellbore in a subterranean formation, particularly a formation comprising oil, gas or other hydrocarbons.

The foregoing description of the invention is intended to be a description of preferred embodiments. Various changes in the details of the described blends and method of use can be made without departing from the intended scope of this invention as defined by the appended claims.